ARPA ORDER NO.: 189-1
5D20 Human Resources Research Office

R-1502-ARPA
June 1975

# Effect of the Variable Reenlistment Bonus on Reenlistment Rates: Empirical Results for FY 1971

John H. Enns

A Report prepared for

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

46

Rand
SANTA MONICA, CA. 90406

The research described in this Report was sponsored by the Defense Advanced Research Projects Agency under contract No. DAHC15-73-C-0181. Reports of The Rand Corporation do not necessarily reflect the opinions or policies of the sponsors of Rand research.

ARPA ORDER NO.: 189-1
5D20 Human Resources Research Office

R-1502-ARPA
June 1975

# Effect of the Variable Reenlistment Bonus on Reenlistment Rates: Empirical Results for FY 1971

John H. Enns

A Report prepared for

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Rand
SANTA MONICA, CA. 90406

Published by The Rand Corporation

# PREFACE

This report was prepared as part of Rand's DoD Training and Manpower Management Program, sponsored by the Human Resources Research Office of the Defense Advanced Research Projects Agency (ARPA). With manpower issues assuming even greater importance than heretofore in defense planning and budgeting, it is the purpose of this research program to develop broad strategies and specific solutions for dealing with present and future military manpower problems. The goals include the development of new research methods for examining broad classes of manpower problems, as well as specific problem-oriented research. In addition to providing analysis of current and future manpower issues, it is hoped that this research program will contribute to a better general understanding of the manpower problems confronting the Department of Defense.

This report presents results of a study of the variable reenlistment bonus (VRB) and its effect on first-term retention. The findings must be regarded as tentative, however, since they are based on an analysis of reenlistment data for only one year, FY 1971. In the next phase of the study, we will be analyzing additional data for FY 1972-73. Upon completion of that work, we will be better prepared to assess the trend in and the overall effect of the VRB on first-term retention.

This study has been developed and coordinated with the Compensation Directorate, OSD/Manpower and Reserve Affairs. The results are intended to be useful for military manpower planners and others responsible for administering the new Selective Reenlistment Bonus (SRB) program. For those concerned with bonus management issues, a recently completed study concerning the Navy's NTPO continuation bonus will also be of interest. That study is described in Craig B. Foch, *The Nuclear-Trained Petty Officer Continuation Bonus: First Year's Experience*, The Rand Corporation, R-1519-ARPA, August 1974.

## SUMMARY

This report attempts to determine the effectiveness of the variable reenlistment bonus (VRB) as an inducement for highly skilled specialists to reenlist in the armed services. The problems of training and retaining such personnel perennially confront the services. Because their principal source of trained personnel is the pool of eligible reenlistees, the reenlistment decisions made at completion of the first term are particularly important.

The services have offered a number of inducements in the past to promote retention, among them being proficiency pay, regular reenlistment bonuses, and, since 1966, the VRB. The VRB is paid only in designated specialties troubled by retention problems. Eligible specialties are assigned multiples from one to four; the total VRB award is then calculated as the product of the multiple and the regular reenlistment bonus. It can run as high as $8000 in award level 4 specialties.

Although some information is available concerning the response of first-term reenlistment rates to increases in aggregate military pay (the Gates Commission studies), very little is known about the separate effect of the VRB. Moreover, there have been no attempts to estimate the VRB's effectiveness while holding constant such factors as personal attributes (race, mental ability, education level), draft motivation, branch of service, type of occupation, civilian earnings alternatives, and other types of military pay.

This report presents the results of initial research designed to estimate the VRB's effect on retention and to control for the factors mentioned. The research method employed resembles that used in past retention studies. A reenlistment supply model is developed--based on the theory of occupational choice--in which the reenlistment rate is hypothesized to be a function of second-term military pay, personal attributes, and that portion of alternative civilian earnings attributable to military experience.

In contrast to most previous work, however, the model presented

here disaggregates second-term military pay into three separate components: the reenlistment bonus (regular plus VRB), proficiency pay, and base pay. All three probably influence the reenlistment decision, but in much different ways. For example, the potential reenlistee knows with certainty what the size of the bonus will be. By contrast, shortage specialty proficiency pay (SSPP) and base pay are uncertain streams of future income; the specialties eligible for proficiency pay may change during the second term, and changes in base pay result from changes in promotion patterns that are difficult to foresee.

Separate supply models are estimated for the Army, Navy, and Air Force using reenlistment data for FY 1971 obtained from the DoD active and separation files. Separate supply equations are also estimated for subgroups with different levels of education, mental ability, and military occupational characteristics.

Based on the regression results, the major findings of this study are:

(1) The VRB is a positive and statistically significant influence on first-term reenlistment rates, holding constant other military pay, alternative civilian earnings attributable to military training, and individual characteristics.

(2) The estimates of the first-term reenlistment supply elasticity with respect to the VRB in the Air Force (3.4) and Navy (2.58) are greater than previous estimates of the supply elasticity with respect to aggregate military pay--2.36 and 2.14 respectively, reported in the 1970 Gates Commission study. The VRB supply elasticity estimate for the Army (2.1) is lower than the Gates Commission estimate (2.43).

(3) The VRB supply response is largest where the proportion of VRB awards paid in lump sum is greatest (as opposed to installment payments). In FY 1971, the proportions of lump sum payments were Air Force 50 percent, Navy 40 percent, and Army 10 percent. The VRB's effectiveness, measured either by supply elasticities or improvement factors, follows the same pattern.

(4) When interservice differences in the proportion of VRB payments paid in lump sum are accounted for, there is no statistical difference in VRB supply response among the three services.

(5) In the Army and Air Force, groups with higher levels of formal education tend to be less responsive to the VRB than groups with less education. Intergroup differences in the distribution of preferences for military life or of civilian earnings alternatives may account for this finding.

(6) The Army and Air Force results suggest that the effect of the bonus varies across DoD occupation groups; the VRB supply response tends to be greater in occupation groups I through III than in groups IV through VIII inclusive. Differences in the demand for reenlistees by type of occupation, or the nonpecuniary aspects of the different jobs, may account for these results.

The regression results are used to construct two additional measures of bonus effectiveness: reenlistment rate improvement factors and bonus costs per incremental man-year. The improvement factor measures the ratio of the reenlistment rate with VRB to the rate that would obtain with no bonus. For VRB award levels one through four, the estimated improvement factors in the Air Force range from 1.12 to 2.25, in the Navy from 1.14 to 1.80, and in the Army from 1.12 to 1.60. A measure of the cost-effectiveness of the VRB is the bonus cost per incremental man-year. Assuming an average reenlistment term of four years, our estimates of the bonus cost per incremental man-year are: Army $3575, Navy $3125, and Air Force $2038. The variation in these costs reflects differences in both average VRB supply response and the pay grade structure among the services.

The present study is limited in several respects. The use of cross-sectional data for a single year prevents accurate measurement of the effect of promotion policy where differences in the level of base pay between skills are partly determined by retention in prior years. A second limitation is that the civilian earnings data used in this study do not measure earning differences among types of individuals. Finally, because of data limitations we were not able to control for differences in marital and dependency status, which affect housing allowances and the value of medical benefits. In the next phase of our research we will be analyzing reenlistment data for FY 1972-73; these more complete data will enable us to overcome at least some of the shortcomings of the present study.

CONTENTS

# I. INTRODUCTION

The armed services continually face the two problems of training and retaining skilled personnel. The reenlistment decisions made at completion of the first term are particularly important because the pool of eligible reenlistees is the principal source of trained personnel. Until recently, it was at that time that the typical enlisted man made his first truly voluntary career decisions; prior to the start of the All Volunteer Force (AVF), the draft undoubtedly motivated the initial enlistment decision of many servicemen. It is also the point in time when separations of skilled personnel are likely to be most expensive to the military, which often has incurred large training costs but may have obtained only a small number of effective man-years of service from the first-term enlisted force.

Past efforts to improve first-term retention in high-training-cost specialties have often included pay incentives. Proficiency pay is one such incentive, and is offered to reenlistees in specified shortage specialties.* It is disbursed as monthly increments to regular base pay. It has a major weakness, however, as an inducement: because the specialties eligible for proficiency pay may change each year, the prospective reenlistee cannot be certain of how much proficiency pay he will receive over his second term. Also, proficiency pay goes to all careerists in a designated specialty who have passed the first-term decision point. As a result, it can be a very expensive way to increase first-term reenlistments, since a large portion of the annual payments go to personnel already committed to a military career.

A second pay incentive offered is the regular reenlistment bonus, paid to people who reenlist in any military specialty. The total sum of such payments cannot exceed $2000 over a twenty-year career period.

---

*There are three types of proficiency pay: Shortage Specialty, Special Duty Assignment, and Superior Performance. Of these three, only Shortage Specialty is designed specifically as a retention incentive and is therefore the only type considered in this study.

For the first reenlistment, the bonus consists of one month of base pay for each year in the reenlistment contract. These bonuses are paid in full at the time of reenlistment, in contrast to the deferred payments offered through proficiency pay. This brings us to the subject of this report: the variable reenlistment bonus (VRB).

## HISTORY OF THE VRB

Prior to 1966, the combination of regular reenlistment bonuses and proficiency pay came to be regarded as inadequate for dealing effectively with selected retention problems. In 1966 Congress therefore approved a new pay incentive, the variable reenlistment bonus (VRB), which combines the selectivity of proficiency pay and the visibility of the regular reenlistment bonus. The VRB is paid only in designated specialties troubled by retention problems. The bonus may be disbursed as a lump sum payment at the time of reenlistment or in annual installments over the reenlistment term. The size of the bonuses can be adjusted to meet retention problems of different severities. The specialties designated eligible for VRB awards are assigned multiples from one to four; the total VRB award is then calculated as the product of the multiple and the regular reenlistment bonus, and can be as large as $8000 in award level 4 specialties.

Table 1 displays some important statistics concerning the VRB program for FY 1968 to 1973. Measured by the number of annual new payments authorized, the VRB program grew rapidly until 1970 and then declined to about its 1968 level. During that period, changes in new payments reflected changes in the number of reenlistments, since the total number of skills eligible for the VRB has remained virtually constant since 1966. As a result, the number of annual new VRB payments has fluctuated in accordance with the size of the initial enlistment cohorts and the policies concerning reenlistment eligibility.

The size of the VRB program, measured in annual dollar costs, has more than doubled during the same period. This growth is somewhat misleading since increases in basic pay have raised the average VRB payment at each award level. However, a portion of the increase in costs can be traced to a shift in distribution of VRB skills toward the

Table 1

VRB PAYMENTS AND COSTS, FY 1968-FY 1973

| Service | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 |
|---|---|---|---|---|---|---|
| | Number of New VRB Payments | | | | | |
| Army | 13,852 | 13,153 | 29,470 | 17,803 | 7,701 | 11,942 |
| Navy | 8,488 | 9,197 | 9,364 | 9,952 | 13,109 | 12,998 |
| Air Force | 8,483 | 12,282 | 11,332 | 11,398 | 13,146 | 5,875 |
| Total | 30,823 | 34,632 | 50,166 | 39,153 | 33,956 | 30,815 |
| | Total VRB Costs (in $ million) | | | | | |
| Army | $22.41 | $ 9.56 | $25.39 | $24.41 | $ 37.96 | $ 54.12 |
| Navy | 14.66 | 18.37 | 27.07 | 30.33 | 37.80 | 53.50 |
| Air Force | 7.05 | 10.84 | 19.81 | 32.78 | 34.05 | 23.65 |
| Total | $44.12 | $38.77 | $72.27 | $87.52 | $109.81 | $131.27 |
| | VRB Payments Lump Sum (%) | | | | | |
| Army | 39 | 4 | 4 | 10 | 73 | 57 |
| Navy | 34 | 26 | 40 | 40 | 30 | 15 |
| Air Force | 6 | 6 | 22 | 50 | 37 | 92 |

SOURCE: Office of Manpower and Reserve Affairs, OSD (unpublished statistics).

highest award levels during the FY 1968-71 period. In FY 1968, 73 Army MOSs (16 percent of all Army skills) were eligible for level 4 awards; by 1971, this number had almost doubled to 137 (31 percent of all skills). Comparable data for the Navy show that only 6 rating/NECs were awarded VRB level 4 in 1968, but 25 in FY 1971. In the Air Force the changes have been small by comparison; in FY 1968, 46 AFSCs (19 percent of all Air Force skills) were eligible to receive level 4 awards; in FY 1971 the number had risen to 50 AFSCs (21 percent).

The rise in VRB award levels from FY 1968 to 1971 probably reflects in part the increased difficulty of securing adequate reenlistments from a draft-motivated enlistment force during the Vietnam conflict. With the cessation of hostilities and general reductions in force levels, the VRB award levels were adjusted downward beginning in FY 1972. The most dramatic reductions have occurred in the Air Force, where improved

retention and diminished requirements reduced the number of VRB-4 AFSCs to 5 during FY 1974.

The distribution of VRB payments according to method of payment--lump sum versus installment--has also changed over the years. Table 1 shows a general upward trend in the use of lump sum payments during 1968-73. Since the payment method directly affects the total annual VRB cost, budgetary constraints may have been an underlying cause of the relatively low frequency of lump sum payments in earlier years. Perhaps equally important, however, is the fact that a lump sum VRB payment should be more attractive to potential reenlistees than are installment payments of equal amount, because of the interest rate effect on deferred payments. Thus, the general increase in lump sum payments may also reflect the services' desire to use the VRB more effectively.

## OBJECTIVES OF THIS STUDY

The primary purpose of this study is to assess the VRB's effect on first-term reenlistment rates.* Although it is generally felt that the VRB has been a success in improving retention, little quantitative evidence has been produced to support such a view.† Moreover, no research has been performed during the last seven years on evaluation of the VRB's effect on retention.

---

*A complete analysis of the VRB program would also include an evaluation of the criteria used to administer the bonus awards. The stated criteria for determining VRB eligibility are that a specialty (1) must require a substantial first-term training investment as measured by the training cost and time involved, and (2) have, or be projected to have, in the near future, a significant career manning shortage due to inadequate retention. In this study, we do not attempt to evaluate the appropriateness of these two criteria or the degree to which they have actually been used as guidelines for VRB policy. A detailed description of the criteria for VRB eligibility and administration is contained in DoD instruction 1304.15, September 30, 1970. For a further discussion of administrative procedures and problems, see *Military Retention Incentives: Effectiveness and Administration*, Comptroller General of the United States, General Accounting Office, No. B-160096, Washington, D.C., June 1974.

†Previous research is discussed in Sec. II.

The type of supply information currently available measures the VRB's average effectiveness by comparing retention improvement in *all* occupations receiving the same award with occupations receiving no VRB (or a different level of VRB).* The usefulness of this type of information for managing specific skills may be severely limited; it seems likely that the supply response to VRB will vary among (1) people with different characteristics (mental ability, level of preservice education, race), and (2) military jobs that offer different nonpecuniary returns. The supply response is also affected by the presence or absence of a draft, the demand for reenlistment, and prevailing political and economic conditions; since all of these factors change over time, one suspects that the VRB's effect will vary among year-groups reaching the first-term decision point.

This study is designed to provide supply information regarding the effect of the VRB. It seeks to answer the following questions:

- What is the VRB's overall effect on first-term reenlistment rates when the other components of second-term military pay and civilian earning alternatives are held constant?
- Does the VRB supply response differ by branch of service?
- How does the effect of the VRB vary between groups of specialties with different job characteristics?
- How does the supply response to VRB vary among people with different attributes (race, education, mental aptitude, and draft motivation)?

It seems particularly important to find answers to these questions at this time. As the transition to the all-volunteer force is being made, the characteristics of the first-term enlisted force (quality, draft motivation, etc.) are changing, and it can be expected that the

---

*The improvement to be expected from various VRB award levels has been quantified as "improvement factors" using reenlistment data for FY 1963-FY 1967. For a discussion of the methods used to compute these "factors," see *Special Pays: Enlisted Attraction and Retention Incentive Pays*, III.21, OSD (M&RA), December 1971 (hereafter cited as *Special Pays*).

response to VRB awards may well change in the future. Furthermore, the research results should be useful in setting up guidelines to administer the new Selective Reenlistment Bonus (SRB) program.* For short-range planning, these estimates of VRB supply response should be more reliable than past estimates, which were derived in the absence of a firm analytical foundation. The scope of this study is limited to providing this type of information. However, the policy implications of the research go beyond short-range planning considerations. For example, our results have potential application for decisions regarding job assignment and training at the time of initial enlistment. Over a longer time period, first-term reenlistments may be improved by a different matching of people to jobs, thus enabling a more selective application of the VRB.

The rest of this report is organized as follows. Section II discusses the research methods used. The section focuses on developing a statistical model of reenlistment supply that isolates the VRB's effect on reenlistment rates. The variables are defined and the data sources used to estimate the model are discussed. Section III presents an overview of the regression results obtained using FY 1971 data. These results are then used to compute three measures of bonus effectiveness. Section IV summarizes our tentative findings and discusses plans for future work. The Appendix presents a detailed discussion of the regression results.

---

*In FY 1975, the VRB program was replaced by the Selective Reenlistment Bonus (SRB). This new program expands the old bonus authority by eliminating the requirement that a regular reenlistment bonus be paid in all skills. Six award levels are now available for purposes of increasing retention in specialties with manning problems. The career maximum for SRB reenlistment bonuses is $12,000 ($15,000 maximum for nuclear-trained personnel).

## II. METHODOLOGY

### PAST RESEARCH

Previous empirical research concerning reenlistment behavior has generally been directed toward measuring the effect of aggregate second-term military pay, alternative civilian earnings, and draft pressure on first-term reenlistment decisions. An exception is a 1968 DoD study* that attempted to derive quantitative estimates of the impact of the VRB (and proficiency pay) using reenlistment data for 1963-67. As noted above, the VRB awards were first offered in 1966. As a result, the DoD study sought to estimate what reenlistment behavior would have been in the absence of the bonus using pre- and post-bonus data. A subset of occupations not receiving the VRB or proficiency pay over the entire period was selected as a control group. The remaining occupations were divided into twelve groups based on the possible combinations of the three proficiency-pay levels and four VRB levels. Average annual reenlistment rates were then calculated for all groups; the percentage improvement resulting from the award of VRB and proficiency pay was estimated by assuming that, in the absence of special pay, the reenlistment rates would have changed by the same percentage as the control group's rate during 1963-67. In general, it was concluded that the percentage improvement was greatest for those groups receiving the highest levels of VRB and proficiency pay; however, some inconsistencies in the results cast doubt on the methodology employed. For example, when the groups were ordered by the total amount of special pay received, some groups with lower levels of payment were found to have greater actual increases in retention than groups with higher payment levels. Reenlistment rates would be expected to vary according to racial, educational, and mental characteristics of the enlisted force as well as changes in alternative civilian incomes, none of which

*See Office of Assistant Secretary of Defense for Manpower and Reserve Affairs, "Review of Proficiency Pay and Variable Reenlistment Bonus Programs," unpublished report, April 1968. The results of this study were used to support the analysis in *Special Pays*.

were controlled for in this study. The somewhat inconsistent results obtained appear to be due to the lack of control for these influences.

To overcome the difficulties encountered in using aggregate data, recent empirical studies of reenlistment supply have relied on data obtained for individual servicemen reaching the first-term decision point. The theoretical model underlying this type of analysis is based on the traditional model of occupational choice.* Each potential reenlistee is assumed to evaluate the pecuniary and nonpecuniary costs and benefits that military and civilian jobs offer. Furthermore, the model assumes that each person can determine a military wage that will make the sum of pecuniary and nonpecuniary benefits of choosing a second term in the military just equal to the sum of benefits to be expected from a civilian career. This wage is termed the reservation wage. Although the reservation wage for a given person is not directly observable by obtaining data on a large number of reenlistment decisions and grouping individual observations, the variation in the proportion of each group that reenlists can be analyzed as a function of alternative income streams.

Accordingly, reenlistment studies such as those presented in the Gates Commission Report† have developed statistical models to explain variations in the retention rate between groups of potential reenlistees. The explanatory variables used in these models have included aggregate military pay, expected alternative civilian earnings, and measures of draft motivation. In addition, variables designed to control for differences in the attractiveness of military service have frequently

---

*For a detailed discussion of this model as applied to the problem of reenlistment supply, see Robert C. Wilburn, *The Supply of Military Manpower: The Impact of Income, the Draft and Other Factors on the Retention of Air Force Enlisted Men*, Memorandum 70-009, Directorate of Personnel Planning, Personnel Research and Analysis Division, USAF, August 1970.

†The Gates Commission Report (November 1970) contains reenlistment supply studies for the Army (Nelson), the Air Force (Wilburn), and the Navy (Grubert and Weiher). See Chapters II-6, II-7, II-8. See also John J. McCall and Neil Wallace, "A Supply Function for First-Term Reenlistees to the Air Force," *Journal of Human Resources*, IV-3, Summer 1969.

been employed; dependency status and the probability of duty in Vietnam are such factors. The observations used to estimate the supply function are formed by cross-classifying groups of enlisted men who have differences in military and expected civilian pay as well as other characteristics that may influence retention behavior. The most frequently used criteria for defining these cells are educational level, AFQT score, race, and military specialty.

Although the occupational choice model applied to reenlistment decisions has provided useful estimates of the supply response to changes in aggregate military pay--as well as to changes in civilian income and draft pressure--only one previous attempt has been made to use this approach to estimate the reenlistment response to special pay incentives.* The results, based on an analysis of 1967 Army reenlistment data, indicate that the reenlistment bonus including VRB is slightly more effective as a retention incentive than either increased promotion or proficiency pay, although the statistical results were of low significance. The study was subject to two limitations: first, the military specialty data were aggregated in groups such that some members of the group were eligible for VRB while others were not; and second, variables reflecting mental ability and preservice education were omitted from the analysis. The research in the present study represents an effort to improve on the methodology of that earlier work.

## CONCEPTUAL MODEL OF SUPPLY

The model of reenlistment supply developed in the present study assumes that a person reaching the end of the first term considers two general factors when making his reenlistment decision: (1) the second-term military pay he can expect to receive, and (2) the civilian pay he may earn if he chooses not to reenlist. Nonpecuniary preferences for military service enter the decision process by shifting the reservation military wage that is required to induce personnel to reenlist. Unlike previous studies, our model distinguishes three major

---

*See Gary R. Nelson, "The Bonus vs. Regular Pay as a Reenlistment Incentive: Some Preliminary Results," Institute for Defense Analysis, N-757, September 1970.

components of second-term military pay: the reenlistment bonus (including VRB), proficiency pay, and base pay. Each is likely to be viewed differently by the prospective reenlistee. He knows the size of the reenlistment bonus (regular plus VRB) with complete certainty since it is calculated using current base pay and the VRB multiplier (which depends only upon military occupation).* This type of pay should be particularly attractive to people who possess few financial assets and tend to behave in a risk-aversive manner. Proficiency pay represents an uncertain stream of second-term income because the specialties eligible for it may be changed during the second term. The uncertainty is reduced, however, to the extent that shortage specialties tend to experience retention problems over relatively long periods of time. Moreover, for the enlisted man who expects to pursue a military career beyond the second term, proficiency pay may represent a permanent increment to base pay since it is paid to all members of a given specialty who have passed the first-term enlistment point.

Information about future military base pay is probably the most difficult for the potential reenlistee to obtain. Variation in promotion rates among specialties is the primary source of that uncertainty. Rapid promotion rates can be the result of two quite different influences. If there is a growing demand for manpower in selected occupations, promotion opportunities and base pay may increase and lead to increased retention. This is an example of a demand-induced change in reenlistment rates. On the other hand, low reenlistment rates during prior years, due perhaps to the distastefulness of certain jobs, may also increase the opportunities for promotion. This is an example of a supply-induced change and may actually be reflected as a negative relationship between the level of base pay and reenlistment rates in a cross-section of data. A priori, it is not clear which influence is likely to dominate.

---

*Although the size of the VRB is known with certainty, the manner of payment--lump sum versus installments--is subject to variation. For example, the data in Table 1 for the Air Force show that, during FY 1969, 5.8 percent of all VRB awards were lump sum, while in FY 1973 the figure was 92 percent.

The alternative to military income over the second term is a time stream of earnings from employment in the civilian sector. The present value of this stream depends upon both the level of earnings and the discount rate that prospective reenlistees attach to deferred payments. The present value of expected civilian earnings influences the reservation military wage and thus the shape of the supply curve for first-term reenlistments. It is difficult a priori to specify precisely the determinants of alternative civilian earnings. To the extent that military skills are directly transferable to the civilian sector, the observed wage rates in related civilian skills may be relevant for the short run. Over longer periods of time, individual characteristics such as education level and mental ability are likely to be more important than prior military experience. In any event, the prospective reenlistee can probably predict second-term military pay more accurately than civilian pay.

Personal attributes at the time of entry into military service also influence both the distribution of reservation military wages and expected civilian earnings. Our model includes variables representing education level, mental ability, race, and enlistment age. Each is likely to influence supply response to the VRB. Higher levels of formal education may heighten a person's awareness of his civilian market alternatives or his desire for further schooling. Differences in mental ability or race may also affect career alternatives and preferences for military life. Finally, when draft motivation and education level are held constant, differences in enlistment age may reflect differences in the preservice employment experience of prospective reenlistees.*

The presence of a draft during 1967-68 complicates our analysis of reenlistment supply behavior during FY 1971. Earlier studies have shown that true volunteers tend to reenlist at substantially higher rates than do draft-motivated individuals. To control for this influence, it would be desirable to have estimates of the proportion of

---

*Older enlistees, at least those who are true volunteers, may hold less positive views of their civilian employment opportunities. See Wilburn, p. 93.

true volunteers contained in each observation group. Unfortunately, such data are not available at the level of disaggregation required for our study. However, there is evidence to suggest that differences in the proportions of true volunteers between groups are closely related to differences in education level, mental ability, race, and age.* Thus, by controlling for individual characteristics in our model, we indirectly control for differences in draft motivation.

STATISTICAL MODEL

The conceptual framework discussed above leads us to formulate a statistical model in which second-term military pay is disaggregated into three separate variables. The form of the supply equation is:†

---

*Wilburn, for example, found that the proportion of true volunteers in 1964 was related negatively to white raciality, higher education levels, and greater mental ability. Older enlistment age also proved a negative influence on the proportion of true volunteers. Because enlistment age may also be a positive influence on reenlistment, for the reason discussed above, it is not clear a priori which effect will dominate.

†The choice of functional form is somewhat arbitrary. In addition to the log model, we also estimated a linear supply function. These results--coefficient signs and pay elasticities--were quite similar to those obtained using the log model (Eq. (1) above). For reasons discussed in Sec. III, the base pay variable was eventually dropped from the model specification. When this variable was omitted, the coefficients of the bonus and civilian earnings tended to be more unstable using the linear model. As a result, we concluded that the log specification was to be preferred, it being less sensitive to the inclusion or exclusion of other military pay variables; consequently, only the log model results are presented in this report.

An alternative functional form, the logit function, has been used in previous reenlistment studies. The simple logit models constrain reenlistment rates to lie between zero and one, and imply an inflection point where the rate = 0.5. We did not use the logit model in this study for two reasons. First, because it is not a primary goal here to predict reenlistment rates, it is not of serious consequence that either the linear or log models may yield estimates of r greater than one. Second, the vast majority of our reenlistment rate data lie between 0.05 and 0.4; thus the existing data do not make use of the asymptotic properties of the logit function.

$$\ln r = \alpha_0 + \alpha_1 B + \alpha_2 PP + \alpha_3 BASE + \alpha_4 Y_c + \beta_1 X_1 \ldots \beta_n X_n + u \quad (1)$$

where ln = natural logarithm,

r = the reenlistment rate,

B = dollar amount of VRB plus regular bonus,

PP = dollar amount of second-term shortage specialty proficiency pay,

BASE = dollar amount of second-term base pay,

$Y_c$ = dollar amount of second-term expected civilian income,

$X_1 \ldots X_n$ = a set of dummy variables denoting race, education level, mental aptitude, and enlistment age of enlisted personnel,

u = error term,

and $\alpha_0$, $\alpha_1$, $\alpha_2$, $\alpha_3$, $\alpha_4$, and $\beta_1 \ldots \beta_n$ are parameters to be estimated.

The observations used to estimate Eq. (1) are formed by classifying personnel according to military occupation (MOS, AFSC, and Rating), level of education, mental aptitude, race, and initial enlistment age. This classification results in a number of cells with zero reenlistments; consequently, these observations cannot be included in the statistical analysis using the log model. Elimination of zero reenlistment rate cells only may bias upward the reenlistment rates of some groups--primarily those with relatively good civilian alternatives (e.g., whites with high education and mental ability). Since those groups tend to have few potential reenlistees in many military specialties, we attempt to minimize this bias by eliminating all observations with less than five potential reenlistees. For the remaining zero reenlistment observations the value of r is set to 0.01.

This procedure yields 832 observations for the Air Force, 610 for the Army, and 196 for the Navy. The relatively small number of cells for the Navy is the result of two considerations. First, Navy ratings are far less detailed descriptors of occupation than are either the Army MOSs or Air Force AFSCs. Secondly, a number of Navy ratings were eliminated from the sample because they contained primarily men serving six-year initial enlistment terms. Inclusion of these ratings would have introduced an upward bias in the calculated reenlistment rates, since six-year obligors "automatically" reenlist at the end of their first four-year term.

This model of occupational choice assumes that the individual bases his reenlistment decision, in part, on a comparison of the present value of alternative income streams. The VRB represents a stock of cash when paid in lump sum, whereas base pay and proficiency pay as well as civilian wages each constitute a flow of earnings. To compare the present values of alternative payment streams, one needs to know the time horizon and rate of discount that characterize first-term reenlistee decisions. Unfortunately, there is very little firm evidence to suggest the appropriate values for these parameters.* Moreover, because the VRB is paid in installment payments as well as in a lump sum, it is not evident that the average reenlistee can regard the bonus as current income. In view of these difficulties, this study uses undiscounted sums of the second-term military pay components and civilian earnings; that is, we assume a four-year time horizon and rely upon the estimated regression coefficients to provide an estimate of the implied discount rate that reenlistees attach to deferred payments over the second enlistment period.†

Estimation Problems

Before turning to the data requirements and our empirical results, it is important to note two potential biases that may be present in

*Because younger men commonly possess few financial assets, one suspects that first-term reenlistment eligibles will have short time horizons and discount future earnings quite heavily. On the other hand, men whose initial enlistment was motivated by a desire to pursue a military career probably have longer time horizons and place a significant value on the retirement benefits accruing after twenty years of service. This latter view is supported by the observation that, historically, career retention rates are substantially higher than first-term reenlistment rates despite the absence of VRB awards for reenlistment past the second term.

†The regression coefficients will also vary between pay components if different amounts of risk are attached to the different income sources. For reasons discussed above, it is unlikely that the different components of second-term pay will be assigned the same risk factors by prospective reenlistees. Therefore, we can only hope to obtain a rough estimate of the discount rate that characterizes first-term reenlistment decisions.

our results. The first can arise from the simultaneous relationship between the level of VRB and retention. Bonus levels are partly determined by past retention behavior; it seems likely that reenlistment rates in prior years will be negatively related to current bonus award levels. Under these conditions the variable measuring VRB (B) will not be independent of the error term in Eq. (1), and estimation using ordinary least squares will yield estimates of the effect of VRB that are biased downward to some unknown degree.*

A second type of possible bias results from our inability to control explicitly for differences in nonpecuniary returns among military jobs. The nature of this specification bias can be illustrated by a simple example. Suppose that in the absence of differences in nonpecuniary returns two specialty groups, H and L, would display identical reenlistment rates. Now consider the case in which reenlistment rates are greater in H because that skill group offers larger nonpecuniary returns and that, based upon low prior retention, the VRB is awarded only in skill group L. If this reenlistment incentive is sufficient to overcome *some* but not all of the differences between H and L, than all else being equal, we will observe a negative relationship

---

*Technically, this problem is known as simultaneous equations bias. To determine the direction of bias in our supply relationship, consider the following two-equation model:

$$r_t = \alpha_0 + \alpha_1 B + \alpha_2 Z + u_t \qquad (1a)$$

$$B = \gamma_0 + \gamma_1 r_{t-1} \qquad (1b)$$

where Z represents the effect of nonbonus influences on retention, and all other variables are defined as above. The observed reenlistment rate last year, $r_{t-1}$, is composed of two components: the true $r_{t-1}$ plus an error term, $u_{t-1}$. If B and $r_{t-1}$ are negatively related, then B will be negatively correlated with $u_{t-1}$. Since $u_t$ is likely to be correlated with $u_{t-1}$--that is, $u_t = \rho u_{t-1} + \varepsilon_t$, where $\varepsilon_t$ is a random error--B is negatively correlated with $u_t$ in Eq. (1a) and estimation using ordinary least squares yields an estimate of $\alpha_1$ that is biased toward zero. Other estimation techniques, such as two-stage least-squares, *may* produce consistent estimators that tend toward unbiasedness; data limitations prevented the use of such methods in this study. For a complete discussion of simultaneous equations bias, see J. Johnston, *Econometric Methods*, McGraw-Hill, New York, 1963, Chapter 9.

between VRB and reenlistment rates when in fact the actual effect of the bonus is positive. These conditions lead to an understatement of the effect of VRB in our regression results.* To correct for this type of bias, one needs more information on the nonpecuniary aspects of military jobs. For example, variables measuring frequency of relocation or time of separation from family might prove useful control variables. It being difficult to obtain the necessary data to construct such variables, however, we did not attempt to control for nonpecuniary differences among military jobs.†

Both the simultaneous equations bias and the specification bias described above exert a negative influence on our estimates of the VRB regression coefficients. Although we cannot be certain of the magnitude of these possible biases, knowledge of their direction is important in itself since it allows us to view our results as lower-bound estimates of the true VRB supply response. In our future work, we will have additional data available and will attempt to correct for both these types of bias.

## VARIABLES AND DATA

### Reenlistment Rate (r)

This study uses the concept of an adjusted reenlistment rate.‡ For the Navy and Air Force the numerator of this rate is formed by

---

*This problem is referred to as the omitted variables problem. The bias is the result of relegation to the disturbance term of an omitted explanatory variable (nonpecuniary returns) correlated with an included variable (VRB). In the example given above, the direction of bias is downward since the bonus and nonpecuniary returns are negatively correlated; i.e., B and u in Eq. (1).

†Although we do not include variables measuring nonpecuniary returns, we do test for differences in VRB supply response among DoD occupational groups. These results are discussed in the following section and in the Appendix. The DoD groupings are based on general job descriptions--electronics, communications, etc.--and thus may reflect differences in the nonpecuniary aspects of military jobs.

‡Reenlistment rates for military occupations may be unadjusted or adjusted. An unadjusted rate is simply the ratio between the number of reenlistees and those eligible to reenlist during a given time

taking all enlistees from the DoD Active File who enlisted during FY 1967 and had reenlisted as of June 30, 1971. For the Army we consider only reenlistees whose initial commitment was for three years; thus, this group is formed by taking all active enlisted personnel who entered the service in FY 1968 and had reenlisted by the end of FY 1971. The denominator includes all reenlistees plus separations from the FY 1967 Navy and Air Force enlistment cohort and an identical group from the FY 1968 Army enlistment cohort. Separations include all personnel who completed their first term of service during FY 1971 and did not reenlist, with the exception of those cases where the separation code indicates misbehavior or otherwise unsatisfactory service. All personnel in the original cohort who had passed their normal first-term reenlistment point but did not separate or reenlist are eliminated from both the numerator and denominator since their first-term decision had not been made at the time the data were obtained. (This group contains all personnel on short-term (less than 2-year) extensions. In our data, they represent a small group--less than 1 percent of the total eligibles.)

Reenlistment Bonus (B)

The total reenlistment bonus offered to personnel in a given military specialty was estimated using data from the individual records contained in the Active File. The regular reenlistment bonus consists

---

period. This rate will vary due to changes in policies concerning early separations and reenlistments and to differences in the size of initial enlistment groups. Adjusted reenlistment rates attempt to control for these discrepancies. For the present study, separation data were limited to those people who left the service during FY 1971. An unknown number of personnel enlisted in FY 1967 (FY 1968 for the Army) and separated prior to FY 1971. These "early" losses are not captured by our separation data. Ignoring this group would lead to an overstatement of the true reenlistment rate for a given enlistment cohort. To adjust for this distortion we assume that the number of early separations from the FY 1967 (FY 1968 for the Army) enlistment cohort is equal to the number of early separations from the next year's enlistment cohort, i.e., FY 1968 for the Air Force and Navy and FY 1969 for the Army. This latter group was obtained from the FY 1971 separation file by identifying all losses with an active duty base date during FY 1968-69.

of one month of base pay multiplied by the number of years in the reenlistment contract. The Navy and Air Force require a four-year reenlistment; the second-term commitment in the Army may be from three to six years. Because our FY 1971 data were inadequate for calculating the exact reenlistment terms chosen by Army personnel, we assume a four-year reenlistment term and compute the average bonus award for that period.

Eligibility for the VRB is determined by MOS codes in the Army, AFSC codes in the Air Force, and Ratings in the Navy. (In FY 1971 some Navy NECs (Naval Enlistment Classifications) were also eligible to receive VRB, but our sample does not contain any of them.) To compute the variable reenlistment bonus, we use the VRB multipliers in effect during FY 1971; for military specialties designated eligible for VRB, the multiplier times the regular reenlistment bonus gives the dollar amount of VRB. The total reenlistment bonus (B) is then equal to the regular reenlistment bonus plus the VRB award.

Because the VRB depends on the size of the regular reenlistment bonus, we again face the problem of varying reenlistment terms in the Army. As noted above, VRB awards in the Army are calculated here assuming a four-year term. That procedure admittedly ignores an important issue, however. For Army reenlistees, two decisions are influenced by the offer of the VRB: the reenlistment decision itself and the length of the second-term commitment. The latter question will be addressed in our future work.

Proficiency Pay (PP)

There are three levels of shortage specialty proficiency pay ($P_1$, $P_2$, $P_3$) for which enlisted men may qualify after completion of their initial enlistment term. The maximum dollar awards per month are \$50 ($P_1$), \$100 ($P_2$), and \$150 ($P_3$). In this study, we assume that prospective reenlistees view specialty award levels as unchanged throughout the second term and that the maximum dollar awards are paid. Like VRB, proficiency pay is awarded to designated Army MOSs and Air Force AFSCs; thus for the Army and Air Force the estimate of second-term proficiency pay for a military specialty is straightforward. In the Navy,

eligibilty for proficiency pay is determined by both NEC designators and Ratings. The problem is more complex for the Navy since a given Rating may include several NEC codes, some eligible for proficiency pay and some not. For this analysis we compute the average FY 1971 proficiency pay paid to individuals in each Rating and use that value in the regression model.

Base Pay (BASE)

Variations in base pay between individuals are due primarily to differences in rank and length of service. Although second-term base pay is influenced by promotion opportunities in a given specialty, there is no simple way of determining the probability of promotion in advance; as a result, the estimates of second-term base pay were constructed using the average rank of personnel facing the reenlistment decisions.* The actual dollar amount of this type of pay was then calculated using the published FY 1971 pay data for enlisted men with five to eight years of service.

Alternative Civilian Income ($Y_c$)

Differences in civilian earnings alternatives may be due to education, race, and mental ability or to variations in the military training. Estimates of the alternative earnings over the second term were constructed using mean hourly wage data reported by separatees about ten months after leaving military service.† When those estimates were formed for each observation cell (defined by military specialty and individual attributes), a large number of cells were empty owing to lack of data for specific subgroups. Rather than reduce the sample

*This procedure thus understates second-term basic pay. However, no estimation problems arise unless promotion patterns among skills are different in the second term from what they were in the first term and prospective reenlistees perceive such differences.

†The data source used is the FY 1971 Post Service File. We assumed a 40-hour workweek and 50 workweeks per year to construct an annual earnings estimate from the hourly wage data. Earnings data for Navy personnel were not available by specialty (rating), and this variable therefore was not used in the Navy regression equations.

size by excluding these cells, we chose to redefine the variable as simply the mean wage for all personnel in a given military specialty; doing so thus primarily captures differences in civilian earnings that may be attributable to differences in military training alone.* The residual differences in earnings alternatives are not captured by the control variables for individual attributes.

This measure of pay suffers from a number of weaknesses. First, the data represent earnings reported only a short time after separation. Some people may have accepted temporary employment while continuing their job search, or accepted training positions leading to career employment at a future date. In either case the wages actually reported may not accurately reflect the civilian income perceptions of eligible reenlistees upon which they based their reenlistment decisions. Furthermore, those influences probably work to reduce interspecialty variation in the civilian earnings data, thus making statistical analysis less reliable.

A second weakness of the measure is also the result of data limitations. Earnings estimates for people who were not employed at the time of the survey or who returned to school after separation are not included in the Post Service File data, and thus could not be included in our sample. The latter group--those who returned to school--tend to be more highly educated and possess greater mental ability; omitting them probably exerts a downward bias on the civilian earnings estimate for at least some specialties.

Finally, it seems likely that a selectivity bias exists owing to the fact that we can observe the civilian earnings only of actual separatees.† If people accurately perceive their civilian earnings alternatives before they make the reenlistment decision, there will be an upward bias of the measured mean civilian earnings relative to the true mean earnings. The bias will tend to be greater as reenlistment

---

*This is not strictly true, however, since individuals with different attributes are not assigned on a random basis to different specialties.

†The problem of selectivity bias is discussed in Adele P. Massell and Gary R. Nelson, *The Estimation of Training Premiums for U.S. Military Personnel*, The Rand Corporation, P-5250, June 1974.

rates rise, since the group of eligibles for which civilian earnings are observed (separatees) is weighted more heavily toward those with high earnings alternatives. Other things being equal, this will tend to push the estimated regression coefficient in a positive direction.

Individual Attributes

Our model of reenlistment supply also includes variables for education level (EDUC), mental ability (AFQT), race (RACE), and enlistment age (AGE). Binary variables were used to represent the individual characteristics in the supply model. The values of these variables are: education level: high school graduate or less (0), some college (1); mental ability: AFQT percentile scores 10-64 (0), 65 and above (1); racial group: white (0), nonwhite (Blacks, Oriental, American Indian, and Spanish surname) (1); enlistment age: less than 19 years, 6 months (0), greater than 19 years, 6 months (1).

# III. EMPIRICAL RESULTS

## OVERVIEW OF THE RESULTS

One purpose of this study is to investigate differences in VRB supply response by service. To do so, separate reenlistment supply equations were estimated for the Army, Navy, and Air Force.* For each service, an all-group supply equation was first estimated using all observation cells. By holding constant civilian income alternatives and individual characteristics, our a priori expectation is that each military pay coefficient will be positive. That is, an increase in total second-term military pay via the VRB, proficiency pay, or base pay should induce a rise in the reenlistment rate although, for the reasons discussed above, that response will probably differ according to the form the pay increase takes. By a somewhat different line of reasoning we expect the age, AFQT, and education coefficients to be negative and the race coefficient to be positive. Owing to differences in draft motivation and civilian earnings alternatives, we expect that older, more able, and more highly educated enlisted personnel will be less inclined to pursue a military career. Since our civilian earnings variable measures only differences in alternative income streams that result from differences in military training, we expect that nonwhites will be more likely to reenlist than whites, owing to disparity in their civilian earnings alternatives.

Table 2 compares, for the three services, actual results with predicted effects of the pay variables and individual characteristics

---

*Two other considerations dictated that separate supply equations be estimated for each service branch. First, as noted above, lack of civilian earnings estimates for FY 1971 Navy separatees prevented inclusion of Navy observations with data from the other two services. Second, the differing lengths of Army and Air Force initial enlistment terms (three years in the Army, four years in the Air Force) as well as of reenlistment contracts (three through six years in the Army, four in the Air Force) suggested separate treatment of reenlistment behavior for the two services.

Table 2

PREDICTED EFFECTS ON RETENTION VERSUS ACTUAL RESULTS

| | Pay Variables | | | | Individual Characteristics | | | |
|---|---|---|---|---|---|---|---|---|
| Effects | VRB | Proficiency Pay | Base Pay | Civilian Earnings | Age | Race | AFQT | Education |
| Predicted | + | + | + | - | - | + | - | - |
| Actual[a] | | | | | | | | |
| Army | + | 0 | - | - | 0 | + | - | - |
| Navy | + | n.a. | - | n.a. | 0 | + | - | - |
| Air Force | + | 0 | - | 0 | - | + | 0 | - |

[a]Taken from all group service equations; + (-) indicates estimated coefficient is statistically greater than (less than) zero at 5 percent level of significance, 0 indicates not statistically different from zero, and n.a. represents omitted variables.

on retention. The initial empirical analysis verified our expectations regarding the VRB, but the effects of proficiency pay are not clear since the estimated coefficients are of low statistical significance. The initial results obtained for base pay show the estimated coefficients to be consistently negative. This result indicates the difficulty of measuring the effect of base pay in a single-year cross-sectional study. As noted earlier, variations in base pay depend primarily upon differences in promotion rates across military specialties. During periods of increased demand for manpower, such as the 1966-67 Vietnam build-up period, the general rise in promotion rates suggests that the data would show a positive relationship between levels of base pay and reenlistment rates. However, if aversion to certain jobs (due perhaps to proximity to the war zone) causes reenlistment rates to be low and results in increased promotion, then in a cross-section of data for a year such as 1971, high base pay may in fact be negatively related to retention rates. In that case, base pay apparently is not an exogenous variable in the model, since it is itself a function of prior reenlistment rates; the base pay variable

was excluded in the final regression results presented in the Appendix.*

We expected the civilian earnings variable to be negatively related to reenlistment rates, because higher civilian earnings alternatives should reduce the proportion of reenlistment eligibles whose reservation military wage exceeds their civilian wage alternative. The empirical results verified this expectation for the Army but not for the Air Force, where the estimated coefficient was statistically insignificant. We have already noted the weaknesses of the measure of civilian earnings used in this study; they probably caused the unsatisfactory results obtained for the Air Force.

Of the four individual characteristic variables, three are included to control for differences in civilian earnings alternatives as well as possible variations in the "taste" for military service between groups of eligible reenlistees.

The first variable, education level, was expected to exert a negative influence on retention because more educated groups possess higher civilian earnings alternatives. The results verified this expectation in all three service equations.

Differences in mental ability were measured in the model by defining two groups based on AFQT score. In that case, as with education level, we expected higher mental ability to bear a negative relationship to reenlistment rates owing to the greater civilian earnings generally available to this group. The Army and Navy results supported that expectation.

The race variable was used to control for possible racial differences in retention behavior. Our results indicate that, of reenlistment eligibles in each service branch, nonwhites reenlist at higher rates than whites. Previous studies have found virtually no racial

---

*The problem of simultaneity between base pay and reenlistment rates resembles the one discussed earlier with regard to VRB and reenlistment rates (see p. 15). The same causal mechanism is responsible for the potential bias in both cases: past retention behavior influences current bonus and pay levels, resulting in a lack of statistical independence between the disturbance term and the independent variables in Eq. (1).

differences in reenlistment behavior when civilian earning alternatives are adequately measured. Since the civilian earnings variable used in this model measures only differences due to military training, the strong effect of race in our results could be due to the disparity in civilian earnings alternatives between white and nonwhite groups rather than to any differences in "taste" for military jobs.

The last control variable, enlistment age, was included primarily to control for individual differences in draft-motivation at the time of initial enlistment. The expectation was that older enlistment cohorts reaching the first-term decision point would contain a higher proportion of the draft-motivated. The Air Force results strongly supported that hypothesis, but in the Army and Navy results the enlistment age variable proved insignificant in the all-group equations. It is possible in the latter cases that the education level variable partially captured the impact of draft-motivation, since enlistment age and education level are substantially correlated in our sample; in both the Army and Navy samples, the simple correlation between age and education level is equal to approximately 0.80.

## MEASURES OF VRB EFFECTIVENESS

Several measures of VRB effectiveness may be derived from the regression results discussed above and presented in the Appendix. One measure is bonus elasticity, which measures the percentage change in the reenlistment rate corresponding to a one percent change in military pay through the VRB. Improvement factors are a second measure of effectiveness; they are defined simply as the ratio of the reenlistment rate with VRB to the rate that would obtain under no-bonus conditions.* Bonus elasticities and improvement factors can be useful tools for short-range planning, but do not permit an analysis of the cost-effectiveness of the VRB vis-à-vis other retention policies. For that purpose, the relevant measure of the effect of a special pay

*This measure has been widely used in judging the VRB as well as other special pays. See *Special Pays*, Sec. IV.

program is the additional man-years of service generated by the program, while the program cost is simply the sum of obligated VRB payments. The ratio of total bonus costs incurred to incremental man-years generated is the relevant measure of the costs versus benefits; this ratio is the bonus cost per incremental man-year obtained. In general, the bonus cost per incremental man-year exceeds the average annual VRB payment because some fraction of the total cost must be paid to personnel who would have reenlisted in the absence of a bonus. We now present our estimates of these three measures based upon FY 1971 data.

Bonus Elasticities

Table 3 lists our estimates of bonus elasticities for the Army, Navy, and Air Force.

Table 3

VRB AND MILITARY PAY REENLISTMENT ELASTICITIES

| Service | VRB Elasticity, FY 1971[a] | Military Pay Elasticity (Gates Commission)[b] |
|---|---|---|
| Army | 2.10 | 2.43 |
| Navy | 2.58 | 2.15 |
| Air Force | 3.40 | 2.36 |

[a]The point elasticity of supply with respect to VRB pay increases is defined as $\varepsilon_b = \partial r/\partial B \times MP/r$, where MP = total second-term military pay. For the functional form used in this study, $\varepsilon_B = \alpha_1 \times MP$, where $\alpha_1 = \partial r/\partial B$ and MP = B + PP + BASE. $\varepsilon_B$ is evaluated at the mean value of MP using the regression results reported in the Appendix for all-service equations.

[b]From Thomas Gates et al., *Studies Prepared for President's Commission on an All-Volunteer Force*, Vol. I, November 1970.

The VRB elasticity is greatest for the Air Force, followed by the Navy and Army. As indicated below, one reason for the differences may

be the way in which the payments were made during FY 1971 (lump sum versus installment). Other differences among the three branches, such as conditions of service, may also explain the measured differences in VRB effectiveness.

At the beginning of this study we raised a question concerning the relative effectiveness of VRB versus other types of military pay. Although our regression results are not adequate to make such a comparison directly, we can draw on previous research results to gain some insight on this question. In addition to the VRB elasticities, Table 3 displays the all-military pay elasticities reported in the Gates Commission studies. Because the Gates results are based on an analysis of FY 1968 data, they are not directly comparable with the results of the present study. However, average reenlistment rates differed only slightly for FY 1968 and FY 1971,* and both year-groups enlisted under conditions of a draft and the Vietnam conflict. Thus, the fact that the VRB elasticities exceed the all-pay elasticities in both the Navy and Air Force results suggests that the VRB--because of its greater visibility and certainty--may be a more effective reenlistment incentive than either proficiency pay or increased promotion opportunity. However, this conclusion is not supported by the Army results, which show the VRB elasticity to be less than the all-pay elasticity.

Improvement Factors

The regression model results also provide an opportunity to construct retention rate improvement factors associated with the various VRB award levels. The improvement factor is defined as the ratio of expected reenlistment rate with VRB to the reenlistment rate with no VRB. In symbols, the improvement factor for VRB award level i is the ratio $r_i/r_o$, where $r_i$ is the reenlistment rate with VRB award level i and $r_o$ is the reenlistment rate with no VRB award. Table 4 presents the estimated reenlistment rates and corresponding improvement factors

*Mean reenlistment rates for FY 1968 were Army 16.9, Navy 15.2, Air Force 15.8. During FY 1971 the corresponding rates were Army 15.6, Navy 15.2, and Air Force 15.6.

Table 4

REENLISTMENT RATE IMPROVEMENT FACTORS, FY 1971

| Service | VRB Award Level | | | | |
|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 |
| Air Force | | | | | |
| Reenlistment rate (%) | 10.2 | 12.5 | 15.3 | 18.7 | 22.9 |
| Improvement factor | | 1.23 | 1.50 | 1.83 | 2.25 |
| Army | | | | | |
| Reenlistment rate (%) | 12.4 | 13.9 | 15.6 | 17.6 | 19.8 |
| Improvement factor | | 1.12 | 1.26 | 1.42 | 1.60 |
| Navy | | | | | |
| Reenlistment rate (%) | 10.3 | 11.8 | 14.2 | 15.9 | 18.5 |
| Improvement factor | | 1.14 | 1.37 | 1.54 | 1.80 |
| All Service | | | | | |
| Improvement factor[a] (FY 1963 - FY 1967) | | 1.30 | 1.35 | 1.65 | 1.75 |

[a]From DoD Instruction 1304.15, September 1970, p. 4.

for different VRB award levels. To arrive at these estimates, the mean reenlistment rate and VRB awards for each service are used to predict $r_o$--the no-VRB reenlistment rate.* The estimated improvement factors are largest for the Air Force, ranging from 1.23 to 2.25. The

*The following formula was used to estimate $r_o$:

$$\ln r_o = \ln r' - \hat{\alpha}_1 \times \overline{VRB}, \qquad (2)$$

where $r'$ = mean reenlistment rate,
$\overline{VRB}$ = mean VRB dollar award, and
$\hat{\alpha}_1$ = the estimated regression coefficient for B, reported in the Appendix.

Similarly, the estimated reenlistment rates for VRB levels 1 through 4 were obtained using the following equation:

$$\ln r_i = \ln r_o + \hat{\alpha}_1 \times VRB_i, \qquad (3)$$

where $r_i$ = estimate of the reenlistment rate for VRB level $i = 1, \ldots, 4$, and
$VRB$ = average dollar award for VRB level $i$.

The mean VRB awards during FY 1971 were Army $3806, Navy $4025, and Air Force $2821.

Army and Navy estimates are significantly lower at each level of the bonus, and are quite similar to the 1968 DoD study estimates constructed using FY 1963-FY 1967 data for pre- and postbonus periods.

Bonus Cost Per Incremental Man-Year

Using the regression results, the bonus cost required to obtain an incremental man-year was also estimated for each service branch. The total annual cost, C, of paying the VRB to reenlistees is:

$$C = r' \times VRB \times N, \tag{4}$$

where $r'$ = actual retention rate with VRB,

VRB = dollar amount of VRB (for the average specialty paygrade and award level), and

N = enlisted population eligible to reenlist.

The number of second-term man-years of service induced by the offer of VRB is

$$\Delta MY = (r' - r_o) \times N \times T, \tag{5}$$

where $r_o$ = estimated reenlistment rate in the absence of the bonus (derived from Eq. (2)), and

T = number of years in the reenlistment contract.

The average bonus cost required to obtain an additional man-year of service is then Eq. (4) ÷ Eq. (5):

$$\frac{C}{\Delta MY} = \frac{r' \times VRB \times N}{(r' - r) \times N \times T}. \tag{6}$$

The mean reenlistment rate and VRB payment data cited above were also used to estimate the bonus cost per incremental man-year.

Table 5 displays our cost and effectiveness estimates for the FY 1971 reenlistees in our sample. Two factors cause the estimate of bonus cost per man-year for the Air Force to be substantially the lowest. First, the marginal response to the VRB was estimated to be

Table 5

BONUS COST PER INCREMENTAL MAN-YEAR, FY 1971

| | | |
|---|---|---|
| Air Force | | |
| Bonus cost | ..... | $11.31 million |
| Additional man-years | .... | 5551 (four-year reenlistment term) |
| Cost per man-year | ..... | $2038 |
| Army | | |
| Bonus cost | ..... | $20.01 million |
| Additional man-years | .... | 5600 (four-year reenlistment term) |
| Cost per man-year | ..... | $3575 |
| Navy | | |
| Bonus cost | ..... | $15.7 million |
| Additional man-years | .... | 5024 (four-year reenlistment term) |
| Cost per man-year | ..... | $3125 |

greatest in the Air Force, as reflected by the regression coefficients and improvement factors. Second, the structure of pay grades during FY 1971 was such that the average basic pay of Air Force first-termers was considerably less than in the other service branches; thus, the average VRB payments were also lower in the Air Force.

To arrive at these estimates, the years of second-term service (T) was defined to be equal to the length of the average reenlistment contract--in this case four years. However, the net increase in man-years induced by the VRB may either fall short of or exceed that time period. If the offer of VRB induces personnel to execute early reenlistments but they do not reenlist again at the second-term point, the *net* man-years of service obtained would be less than the normal four-year reenlistment contract.* In that case, the bonus cost per incremental man-year obtained would exceed the estimates shown above.

Alternatively, the incremental man-years obtained from paying the VRB may exceed the normal reenlistment period if second-term personnel

*First-term personnel become eligible for the VRB after twenty-one months of service. If early reenlistment policies allow the first reenlistment to be executed at this time and no further reenlistments occur, then a total of six years of service is involved. Thus, the additional years of service obtained from the VRB award is actually two years rather than the four years implied by the reenlistment contract.

who would not have been retained in the absence of the bonus chose to reenlist in subsequent terms. It seems likely that at least some proportion of the reenlistees who would not have reenlisted in the absence of the VRB will execute subsequent reenlistments owing to the growth in present value of their retirement benefits. To the extent that they do, the bonus costs per incremental man-year will actually be less than the estimates presented above since, on the average, more than four years of additional service have been obtained.

Unfortunately, our FY 1971 data for this study of reenlistment behavior were not sufficient to permit an analysis of the relative frequency of early reenlistments or second-term reenlistments by occupational specialty. We plan to examine these questions in future work using FY 1972-73 data. It will then be possible (1) to test for differences in early reenlistments frequency between specialties receiving varying VRB awards, and (2) to examine the indirect impact of the VRB on second-term reenlistment behavior.

## DIFFERENCES IN VRB SUPPLY RESPONSE

### Level of Education and Mental Ability

The total sample of white enlisted men was stratified by education level and AFQT group to test for differences in bonus response (see the Appendix for regression results). In the Army the estimated VRB elasticity is 2.4 for the group with less than high school education, and 2.1 for high school graduates. In the Air Force the estimated elasticity is 3.8 for high school graduates and 3.0 for the group with some college education. Both results suggest that groups with higher levels of preservice education tend to be less responsive to the bonus. A possible explanation is that the distribution of reservation military wages may be more concentrated in the relevant pay range for the less educated groups;* under these conditions, a relatively larger proportion of this group would be induced to reenlist at the margin, by the offer of VRB.

*For example, this would tend to occur if less educated groups place relatively less importance on the nonpecuniary aspects of service life.

In the Navy sample, stratification by mental ability resulted in VRB elasticity estimates of 3.3 for AFQT group I-II and 1.1 for group III. This result is difficult to explain. To the extent that initial job assignment in the Navy is based on AFQT scores, this result may reflect differences in the nonpecuniary aspects of the jobs to which groups with different mental ability are assigned. However, our inability to completely control for civilian earnings alternatives in the Navy may be responsible for this result.

DoD Occupational Group

The Army and Air Force samples were also stratified by DoD occupation group.* In general, the estimated VRB response is greatest in the technical occupations (DoD groups I, II, and III). However, an important limitation accompanies this result: in our sample, average VRB awards tended to be low in occupation groups IV-VIII, and as a result we may not have obtained an accurate measurement of VRB effectiveness for these groups. Further work with additional data is required to reach firm conclusions on this question.

LUMP SUM VERSUS INSTALLMENT PAYMENTS

Interservice differences in bonus effectiveness may result from differences in the types of people the services attract or the jobs they perform, but another explanation is possible. In our model the VRB payments were measured as lump sum payments in all cases; therefore any differences in supply response resulting from differing VRB payment policies (i.e., lump sum versus installment) among groups of reenlistees are captured in the estimated regression coefficients. In general, we would expect the marginal response to VRB awards to be greatest where lump sum payments are more frequent, owing to the larger expected present value of the bonus in this form.†

*See the Appendix for regression results. The Navy sample was not stratified by occupational group because many Navy ratings are contained in two or more DoD groups.

†A reenlistee must file a special request to receive the VRB in lump sum. Although individuals cannot be certain that such requests

Data on the distribution of lump sum versus installment payments are available for FY 1971 for each of the three service branches (see Table 1). These data show that lump sum VRB awards amounted to 50 percent for the Air Force, 40 percent for the Navy, and 10 percent for the Army. The regression results in the Appendix show that our estimate of the bonus coefficient for the all-group equations is highest in the Air Force (0.149), next highest in the Navy (0.108), and lowest in the Army (0.082). These results are therefore consistent with the expectation that the form of payment affects reenlistment response to the VRB, lump sum awards inducing the greater marginal response.

If we assume that VRB supply response is identical across services, the differences in our estimates of the bonus response are due either to sampling error or to differences in the expected present value of bonus awards. Ignoring sampling errors, the ratio between any two service coefficients is equal to the ratio between the present value of VRB payments for the two service branches. The rate of discount implied by this equality condition for the estimated coefficients in our model is 40 percent for Air Force/Navy, and more than 75 percent for both Air Force/Army and Army/Navy.* While there are good reasons

---

will be granted, it seems very likely that they receive some idea of the likelihood of their receiving lump-sum awards during the reenlistment counseling process.

*To illustrate the calculation for the Navy and Air Force, we begin with the following identity:

$$\frac{B_N \times \alpha_{1(N)}}{B_{AF} \times \alpha_{1(AF)}} = \frac{PV_N \times \gamma_{1(N)}}{PV_{AF} \times \gamma_{1(AF)}} \equiv 1,$$

where $B_N$, $B_{AF}$ = one dollar of bonus undiscounted,
$\alpha_{1(N)}$, $\alpha_{1(AF)}$ = estimated VRB coefficients from Eq. (1),
$PV_N$, $PV_{AF}$ = present value of one dollar of bonus, and
$\gamma_{1(N)}$, $\gamma_{1(AF)}$ = VRB coefficients with B adjusted for differences in present value.
$B_N = B_{AF}$ by definition, and we assume $\gamma_{1(N)} = \gamma_{1(AF)}$. Thus:

$$\frac{\alpha_{1(N)}}{\alpha_{1(AF)}} = \frac{PV_N}{PV_{AF}} = 1,$$

for believing that the discount rates of young servicemen are high, these values seem unrealistically large. Thus, variation in bonus payment policy alone does not seem adequate, under the above assumption, for explaining the disparity in the estimated bonus coefficients between service branches.

Of course, it is possible that when VRB payment policy differences are accounted for, sampling error alone is responsible for any remaining differences in bonus responsiveness between the services. To check this possibility we performed a statistical test for equivalence among the bonus coefficients adjusted for differences in the expected present value of VRB awards paid during FY 1971. Using an assumed discount rate of 25 percent, the adjusted VRB coefficients are: $\alpha_{AF} = 0.171$, $\gamma_{Navy} = 0.128$, and $\gamma_{Army} = 0.107$. A t-test was used to test the null hypotheses that $\gamma_{AF} = \gamma_{Navy}$, $\gamma_{AF} = \gamma_{Army}$, and $\gamma_{Navy} = \gamma_{Army}$. The t-statistics* obtained for these three cases are 1.6, 1.2, and 0.6. In each case a value of 1.96 or greater, using a two-tailed test, is required to reject the null hypothesis at the 95 percent level of confidence. Thus, on statistical grounds, we conclude that the supply response to the VRB does not vary among the services when differences in payment policy are taken into account. (This conclusion holds true for any assumed discount rate above 4 percent.)

---

where $PV_N = 0.4 + \Sigma_{n=o}^{3}\ 0.15/(1 + i)^n$ and $PV_{AF} = 0.5 + \Sigma_{n=o}^{3}\ 0.152/(1 + i)^n$. The ratio $\alpha_{1(N)}/\alpha_{1(AF)} = 0.108/0.149 = 0.725$ using the all-group equation results in the Appendix. Setting $PV_N/PV_{AF} = 0.725$ and solving for i yields an estimated discount rate of 40 percent. Similar calculations using the ratio of Army/Navy and Army/Air Force coefficients result in estimates of i equal to 78 percent and 92 percent respectively.

*The t-statistic is defined as:

$$t = \frac{\hat{\alpha}_1 - \hat{\alpha}_2}{\sqrt{\hat{\sigma}_1^2 + \hat{\sigma}_2^2}},$$

where $\hat{\alpha}_1$ and $\hat{\alpha}_2$ are the estimated bonus coefficients from two regressions and $\hat{\sigma}_1^2$ and $\hat{\sigma}_2^2$ are the associated estimates of the standard errors.

# IV. CONCLUSION

## PRESENT FINDINGS

This report represents only a first step toward understanding the impact of the VRB on first-term reenlistment decisions. Our analysis has dealt with a single year-group that reached the first-term reenlistment point during FY 1971. Because that group enlisted at the peak of the Vietnam war, during a period of high draft calls, our findings must be viewed as preliminary. In fact, our results have probably raised as many questions as they have answered. Nevertheless, it seems useful at this point to reexamine the issues raised at the beginning of this report in the light of our empirical results and summarize our tentative conclusions.

The effectiveness of the VRB on first-term reenlistment rates during FY 1971 seems clearly established by the statistical results. In each of three service supply models, the estimated coefficient measuring the marginal response of the reenlistment rate to bonus awards proved positive, substantial, and statistically significant. However, the regression results do not provide a sound basis for assessing the relative influence of the VRB versus other types of military pay. Although proficiency pay did not prove to be a statistically significant influence on first-term reenlistment rates, the effect of base pay on reenlistment rates was found to be negative--a distinctly implausible result, for which the experimental design employed in this initial study is probably at fault. Differences in promotion rates are probably due in part to past manpower shortages, and a cross-sectional analysis of a single year-group is likely to yield misleading results.

There is some evidence that different subgroups of the first-term enlisted force differ in their reenlistment response to bonus awards. In the Air Force and Army, education level proved to be an important factor; the more highly educated groups tend to be less responsive to the VRB. This may indicate differences in the underlying distribution of preferences for civilian life among these groups. In the Navy, our results suggest that groups with higher mental ability (measured by

AFQT score) are more responsive to the bonus; this finding may reflect the Navy's training and initial job assignment policies.

There is also some indication that effectiveness of the bonus varies across DoD occupational groups. In the Army and Air Force, the reenlistment rates of specialties in DoD occupational groups I-III seem generally more responsive to VRB than in other job categories. However, an important caveat accompanies this conclusion: VRB awards in DoD occupational groups IV, VI, VII, and VIII as a whole tended to be quite low in our sample; as a result, the lack of variation in bonus awards may have prevented an accurate estimate of VRB effectiveness for these occupation groups. Further tests with additional data are necessary before reaching conclusions on this question.

The interservice results are consistent with the expectation that lump sum payment of the VRB has a greater marginal effect on reenlistment rates than do installment payments. During FY 1971 the frequency of lump sum VRB payments was highest in the Air Force, followed by the Navy and Army, respectively. The effectiveness of the VRB, measured either by the bonus coefficients or the bonus elasticities, follows the same sequence. However, when the estimated bonus coefficients across services are adjusted for differences in the frequency of lump sum payments, there is no statistical difference between service branches in the VRB supply response.

For the Air Force and Navy, our estimates of the supply elasticity with respect to the VRB are higher than previous elasticity estimates using aggregate military pay. The Gates Commission studies, based on FY 1968 reenlistment data, concluded that the supply elasticities in the Air Force and Navy are 2.36 and 2.15, respectively. Our estimates of the bonus elasticity for the Air Force and Navy are 3.40 and 2.58; and our estimate for the Army is 2.1, which is lower than the Gates Commission all-pay elasticity of 2.43. Thus, while the evidence is not conclusive, there is at least limited support for the view that the supply elasticity is greater when second-term military pay is increased through the use of the bonus rather than through other types of pay.

PLANS FOR FUTURE WORK

As indicated by the preceding discussion, a number of problems remain, and work currently in progress will attempt to remove some of the shortcomings of the present analysis. Specifically, we plan to estimate the supply model using FY 1972 and FY 1973 reenlistment data obtained from the DoD Active and Separation Files. This new data source contains information on the marital and dependency status of first-termers; as a result, we will be able to make more accurate estimates of the second-term base pay actually received by military personnel. In addition, at the time of reenlistment, married servicemen may view the benefits offered by a military career much differently from single men; we also plan to investigate this question using the FY 1972-1973 data.

The estimates of civilian income alternatives used in this study are quite crude; they are based solely upon the actual earnings reported by separatees about ten months after they left the service. To the extent that military training is transferable to the civilian job market, these earnings may accurately reflect the alternatives facing the prospective reenlistee. However, many separatees either return to school or take jobs in fields unrelated to their service experience; as a result, the civilian earnings estimates used in this study do not include variations due to differences in individual characteristics, and are probably biased downward. At present, another Rand study* is attempting to estimate civilian wage offers for veterans based upon military experience and individual characteristics (mental ability, race, and education level). We plan to use the output of this research to improve the measurement of the alternative civilian earnings variable in our model of reenlistment supply.

Estimating the supply model with additional data and variables will provide a test of the validity of the results presented in this report. In addition, we are planning to apply the statistical results to the problem of forecasting first-term reenlistment rates. With three years of data (FY 1971-1973) we can use the regression results from the first two years to predict first-term reenlistment rates in

*See Massell and Nelson, op. cit.

FY 1973; comparison of actual data with the predicted values will provide a test of forecasting power of the model. There is a difference, of course, between forecasting the absolute *level* of reenlistment rates and predicting the effect of VRB on reenlistment rates. The former is a much more difficult exercise owing to the fact that political, social, and economic conditions affecting different year-groups of reenlistees are likely to vary considerably over time. Nevertheless, the results of this extended research should provide a useful input for planning the future use of VRB awards and other military pay strategies.

Finally, although this report was limited to an analysis of first-term retention behavior, perhaps an equally important issue for manpower planning concerns the effect of the VRB on second-term reenlistments. It is likely that some proportion of the additional manpower retained by the VRB will choose not to reenlist upon completion of the second term since, aside from the regular reenlistment bonus, no further special pay incentives have been offered.* On the other hand, some of the marginal first-term reenlistees will likely attach more weight to their accrued retirement benefits at the second decision point and execute further reenlistments. This question of the effect of VRB on career decisions remains largely unexplored to date, in part because the data required to examine the second-term decisions of personnel who have received the VRB has only recently become available.

In the next phase of this study we plan to examine this question in detail using our expanded data base. An initial step will be to compare the second-term reenlistment rates of first-term no-VRB specialties with the corresponding rates of the four award level groups of VRB specialties. If this analysis reveals significant differences among specialty groups, a more ambitious task will be to estimate a second-term reenlistment supply function that includes control variables for first-term VRB status as well as variables measuring differences in military and civilian pay and individual characteristics. The results of this additional work should provide a useful complement to the analysis of the VRB's effect on first-term retention.

---

*Under the new Selective Reenlistment Bonus (SRB) program, second-term bonuses (zone B bonuses) may be authorized.

# Appendix
## REGRESSION RESULTS

A principal purpose of this study was to explore the differences in the effect of the VRB by service branch, between occupation groups, and among groups of individuals with different characteristics. This Appendix presents the regression results for each of the service branches. We begin with the supply model for the Air Force which, in general, provided the most satisfactory results.

### AIR FORCE EQUATIONS (Table 6)

The all-group equation in Table 6 was estimated using all AFSCs in the sample.* The coefficient of the bonus is 0.149, and it is significantly different from zero at the 5-percent level of significance.† The coefficient of proficiency pay is small by comparison, but is not significantly different from zero. The sign of the civilian earnings coefficient is positive, contrary to prior expectations, but not significantly different from zero. The individual characteristic coefficients imply that nonwhites reenlist at higher rates than do whites and that higher levels of education are a negative influence on retention.

Separate supply equations were estimated for two of the largest groups in the Air Force, white high school graduates and whites with some college (lines 2 and 3 of Table 6). The results indicate that the marginal effect of the bonus is approximately one-third greater for high school graduates (0.176 versus 0.129). There are a number of possible explanations for this result. First, the two groups may possess different distributions of nonpecuniary tastes for military service. That is, the distribution of reservation military wages for

---

*The reenlistment supply function (Eq. (1)) was estimated using the method of ordinary least squares and weighting the observations to correct for heteroscedasticity. For the log-linear form, the appropriate value for the weights is the square root of the number of individuals contained in each cell.

†Throughout this section the level of significance referred to is the 5-percent level of significance.

Table 6

REENLISTMENT SUPPLY MODEL: REGRESSION RESULTS FOR AIR FORCE EQUATIONS

| Sample | Constant | Bonus ($000) | Proficiency Pay ($000) | Civilian Earnings ($000) | Individual Characteristics[a] | | | | $R^2$ | F Statistic | df |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AGE | RACE | AFQT | EDUC | | | |
| All groups combined | -0.96[b] | 0.149[b] | 0.016 | 0.008 | -0.22[b] | 0.70[b] | -0.03 | -0.75[b] | 0.35 | 18.1[b] | 763 |
| White high school graduates | -2.3[b] | 0.176[b] | 0.019 | 0.002 | -0.14[b] | -- | 0.075 | -- | 0.35 | 22.9[b] | 210 |
| White with some college | -2.9[b] | 0.129[b] | 0.009 | 0.021 | -0.37[b] | -- | -0.22[b] | -- | 0.22 | 6.7[b] | 120 |
| Electronic equipment repairmen | -1.0[b] | 0.099[b] | 0.027 | -0.006 | -0.17[b] | 0.45[b] | -0.11[b] | -0.79[b] | 0.30 | 4.8[b] | 211 |
| Communications and intelligence | -2.9[b] | 0.195[b] | base pay 0.085 | 0.008 | -0.46[b] | 0.99[b] | 0.07 | -1.7[b] | 0.47 | 12.6[b] | 97 |
| Medical and dental | -3.2[b] | 0.214[b] | base pay 0.138 | 0.019 | -0.42 | 1.0[b] | 0.008 | -0.45 | 0.44 | 13.1[b] | 101 |
| Electrical, mechanical equipment repairmen | -1.7 | 0.147[b] | -0.006 | -0.020[b] | -0.11 | +0.78[b] | -0.14 | -0.93[b] | 0.38 | 12.2[b] | 341 |

NOTE: The dependent variable in each equation is the natural logarithm of the reenlistment rate.

[a]Dummy variable values: AGE: 1 for enlistment age > 19 years, 6 months; 0 otherwise. RACE: 1 for nonwhite; 0 white. AFQT: 1 for mental group I or II; 0 otherwise. EDUC: 1 for some college education; 0 otherwise.

[b]Statistically significant at the 5-percent level.

high school graduates, the less educated group, may be more concentrated in the relevant pay range, and at the margin a relatively greater proportion can be induced to reenlist by the offer of the VRB.

This explanation implies that the underlying supply curves facing the Air Force for the two groups are different. Alternatively, the supply curve may in fact be identical for the two groups but our estimates merely reflect the slope at two different portions of this curve. Further work with additional data and alternative functional forms of the supply equation are required to reach more definitive conclusions on this question.

The total Air Force sample was also stratified by DoD occupational group* and separate supply functions were estimated (Table 6). The results show considerable variation among the estimates of the bonus coefficients. In the communications/intelligence and medical/dental groups, the estimated response to the bonus is considerably greater than in the other occupation groups. In the electrical/mechanical repair group equation, the coefficient of civilian earnings is negative and statistically significant (although quantitatively small), a result that agrees with our prior expectations.

In all the Air Force equations, the enlistment age variable exerts a negative influence on retention. As noted above, this variable was included primarily to control for varying levels of draft-motivation. The negative coefficients obtained support the view that men who enlisted later in their careers are more draft-motivated than their younger counterparts.

ARMY EQUATIONS (Table 7)

The estimated coefficients using all Army specialties appear in the first line of Table 7. The coefficient of the bonus is 0.082, considerably less than the estimate obtained for the Air Force. The

---

*Four occupational groups were defined: electronic repair (DoD group I), communications/intelligence (DoD group II), medical/dental (DoD group III), and electrical/mechanical repair (includes specialties in three-digit DoD codes 400, 610, 702, 712, 721, 780, and 800). In DoD groups II and III, proficiency pay was not awarded; in those two equations the base pay variable was retained in the regression.

Table 7

REENLISTMENT SUPPLY MODEL: REGRESSION RESULTS FOR ARMY EQUATIONS

| Sample | Constant | Bonus ($000) | Proficiency Pay ($000) | Civilian Earnings ($000) | Individual Characteristics[a] | | | | $R^2$ | F Statistic | df |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AGE | RACE | AFQT | EDUC | | | |
| All groups combined | -0.59[b] | 0.082[b] | 0.012 | -0.053[b] | 0.028 | 0.74[b] | -0.22[b] | -0.67[b] | 0.32 | 10.2[b] | 631 |
| White less than high school | -1.03[b] | 0.097[b] | 0.013 | 0.083 | 0.61[b] | -- | 0.16 | -- | 0.25 | 9.6[b] | 139 |
| White high school graduates | -0.62[b] | 0.079[b] | -0.032 | -0.017[b] | 0.25[b] | -- | -0.16[b] | -- | 0.11 | 5.3[b] | 239 |
| Electronic equipment repairmen | -1.034 | 0.118[b] | -0.0093 | -0.025 | 0.012 | 0.78[b] | -0.31[b] | -0.97[b] | 0.46 | 21.9[b] | 186 |
| Communications and intelligence | 1.16[b] | 0.122[b] | 0.0075 | -0.12[b] | -0.29[b] | 0.74[b] | -0.21[b] | -0.67[b] | 0.33 | 11.4[b] | 162 |
| Medical and dental | -0.655 | 0.074 | 0.092[b] | -0.053[b] | 0.30 | 0.56[b] | -0.38[b] | -0.71[b] | 0.27 | 6.4[b] | 121 |
| Electrical, mechanical equipment repairmen | -3.3[b] | -0.064 | 0.067[b] | 0.069 | 0.34[b] | 0.80[b] | -0.02 | -0.84[b] | 0.42 | 12.2[b] | 118 |

NOTE: The dependent variable in each equation is the natural logarithm of the reenlistment rate.

[a]Dummy variable values: EDUC: 1 for high school graduate or some college; 0 less than high school. See footnote (a), Table 6, for values of the other dummy variables.

[b]Statistically significant at the 5-percent level.

proficiency pay coefficient is positive but statistically insignificant. Unlike the Air Force equations, civilian earnings attributable to military training exert a strong negative influence in the all-group Army results.

Disaggregation by race and education level provided the second and third equations in Table 7. The results indicate that whites with less than high school education are more responsive to the bonus than are white high school graduates, although the difference is not quantitatively large. As with the Air Force, this result may indicate that the distribution of reservation military wages may be more concentrated in the relevant pay range for groups with lower levels of education.

When stratified by DoD occupation group, the Army data also display considerable variation in the bonus coefficients. Both the electronic equipment repair and communications/intelligence specialty group equations exhibit higher estimates of the bonus coefficient than those in the all-group equation. Civilian earnings are seen to be a negative and statistically significant influence on retention in the medical/dental and communications/intelligence equations. Proficiency pay is significant and quantitatively large in the medical/dental and electrical/mechanical repair group equations; however, in these specialty groups the average level and variation in VRB awards is quite low.

NAVY EQUATIONS (Table 8)

The pay variables included in the Navy equations were limited to the bonus and base pay. Because civilian earnings data were not available from the 1971 Post-Service file by rating, that variable could not be entered in the model. The proficiency pay variable was also omitted because it was paid primarily to enlisted personnel in occupations with six-year initial obligations. The elimination of these specialties from the sample eliminated all of the ratings and NECs eligible for proficiency pay; as a result this variable was dropped from the equation.*

*Because the civilian earnings and proficiency pay variables were omitted, base pay was retained in Navy equations. However, in each case its influence is negative, as in the unreported results for the Army and Air Force.

Table 8

REENLISTMENT SUPPLY MODEL: REGRESSION RESULTS FOR NAVY EQUATIONS

| Sample | Constant | Bonus ($000) | Proficiency Pay ($000) | Base Pay ($000) | Individual Characteristics[a] | | | | $R^2$ | F Statistic | df |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | AGE | RACE | AFQT | EDUC | | | |
| All groups combined | 5.7[b] | 0.108[b] | -- | -0.522[b] | 0.31 | 1.2[b] | -0.074 | -0.31[b] | 0.25 | 8.9[b] | 212 |
| AFQT I and II | 6.1[b] | 0.135[b] | -- | -0.052[b] | 0.18 | 1.2[b] | -- | -0.55[b] | 0.22 | 12.7[b] | 121 |
| AFQT III | 9.3[b] | 0.045[b] | -- | -0.67[b] | 0.63[b] | 0.99[b] | -- | -1.0[b] | 0.30 | 8.9[b] | 90 |

NOTE: The dependent variable in each equation is the natural logarithm of the reenlistment rate.

[a]For values of the dummy variables, see footnote (a), Table 6.

[b]Statistically significant at the 5-percent level.

The first line in Table 8 shows the estimated Navy supply function using all ratings combined. The coefficient of the bonus is 0.108, somewhat greater than the estimate for the Army and considerably less than that for the Air Force.

The Navy sample was also stratified by individual characteristics to test for differences in VRB supply response. Disaggregation by education level produced no significant differences in the VRB coefficients. However, disaggregation by AFQT mental category provided some interesting results (lines 2 and 3). Although the average VRB level eligibility of personnel in mental group I/II was almost equivalent to that of mental group III (2.7 versus 2.5), the regression results indicate that the marginal response of reenlistments to VRB is roughly three times greater in the higher mental groups. A possible explanation for this finding lies in the nature of first-term training and job assignment in the Navy. If personnel with low mental aptitude are systematically excluded from high skill specialties, then this group may tend to view their Navy jobs as unsatisfactory for a career and be less responsive to pay incentives at the first-term reenlistment point. Alternatively, these personnel may be serving in specialties that have an excess supply of reenlistees; thus, demand constraints may have eliminated the evidence regarding the effect of VRB on retention.

As in the Air Force and Army equations, the nonwhite and education level variables exert a positive and a negative influence, respectively, on Navy reenlistments. The age of enlistment variable proved insignificant in two of three Navy equations; in the AFQT III equation, enlistment age is positive and significant.

## BIBLIOGRAPHY

Comptroller General of the United States, *Military Retention Incentives: Effectiveness and Administration*, General Accounting Office, B-160096, Washington, D.C., 1974.

Gates, Thomas, et al., *Studies Prepared for the President's Commission on an All-Volunteer Armed Force*, February 1970.

Johnston, J., *Econometric Methods*, McGraw-Hill, New York, 1963.

Massell, Adele P., and Gary R. Nelson, *The Estimation of Training Premiums for U.S. Military Personnel*, The Rand Corporation, P-5250, June 1974.

McCall, John J., and Neil Wallace, "A Supply Function for First-Term Reenlistees to the Air Force," *Journal of Human Resources*, IV-3, Summer 1969.

Nelson, Gary R., "The Bonus vs. Regular Pay as a Reenlistment Incentive: Some Preliminary Results," Institute for Defense Analysis, N-757, September 1970.

Office of Manpower and Reserve Affairs, OSD, *Special Pays: Enlisted Attraction and Retention Incentive Pays*, III.21, December 1971.

Wilburn, Robert C., *The Supply of Military Manpower: Impact of Income, the Draft and Other Factors on the Retention of Air Force Enlisted Men*, Memorandum 70-009, Directorate of Personnel Planning, Personnel Research and Analysis Division, USAF, August 1970.